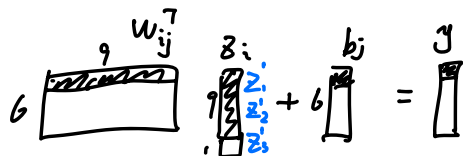
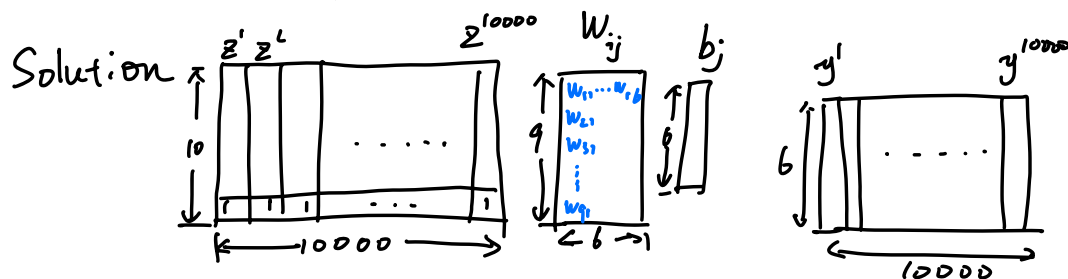


23-52 - Q 23

Q: $3 \times 3 \rightarrow 100 \times 100 \rightarrow 10000$ $z^k = (z_1^k, z_2^k, \dots, z_9^k, 1)^T, k=1 \sim 10000$

$y^k = (y_1^k, \dots, y_6^k)^T$ w_{ij} and b_j

(a) $z_i^k \rightarrow y_j^k$?



$y_j^k = \sum_{i=1}^9 w_{ij} z_i^k + b_j$ ($j=1, 2, \dots, 6$)

Ⓣ 标量, 不能转置, 也不用转置, 不是矩阵

$y_1^k = \sum_{i=1}^9 w_{i1} z_i^k + b_1$

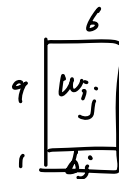
(b) $W?$ $z^k \rightarrow y^k$

$= w_{11} z_1 + w_{21} z_2 + \dots + w_{91} z_9 + b_1$

Solution

we can construct the weight matrix W of size 10×6 where each column corresponds to the weight w_{ij} and the last one is bias b_j

$$W = \begin{bmatrix} w_{11} & w_{12} & \dots & w_{16} \\ w_{21} & w_{22} & \dots & w_{26} \\ \vdots & \vdots & \ddots & \vdots \\ w_{91} & w_{92} & \dots & w_{96} \\ b_1 & b_2 & \dots & b_6 \end{bmatrix}$$



$y^k = W^T z^k$

$$(c) \quad w_j = \begin{bmatrix} w_{1j} & w_{2j} & w_{3j} \\ w_{4j} & w_{5j} & w_{6j} \\ w_{7j} & w_{8j} & w_{9j} \end{bmatrix}$$

$$Y_j(u, v) = \sum_{s=-1}^1 \sum_{t=-1}^1 w_j(s+1, t+1) \cdot X(u-s, v-t) + b_j$$

$$Y_j = X * w_j + b_j$$

* mean convolution operation

(d) Each of the 100 training image of size 100×100 provide 10000 samples

Therefore ,

$$\begin{aligned} \text{Number of training sample} &= 100 \text{ images} \times 10000 \text{ sample/image} \\ &= 1,000,000 \end{aligned}$$